Badger Meter Europa GmbH

iSonic 3000

Ultrasonic flow meter for open channels

USER MANUAL

April 2015

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1. Basic safety recommendations

Before installing or using this product, please read this instruction manual thoroughly. Only qualified personnel should install and/or repair this product. If a fault appears, contact your distributor.

Installation
Do not place any unit on an unstable surface that may allow it to fall.
Never place the units above a radiator or heating unit.
Route all cabling away from potential hazards.
Isolate from the mains before removing any covers.

Power connection
Use only the type of power source suitable for electronic equipment. If in doubt, contact your distributor. Ensure that any power cables are of a sufficiently high current rating.
All units must be earthed to eliminate risk of electric shock.
Failure to properly earth a unit may cause damage to that unit or data stored within it.

Protection class
The device has protection class IP 67 and needs to be protected against dripping water, water, oils, etc.

Setup & operation
Adjust only those controls that are covered by the operating instructions. Improper adjustment of other controls may result in damage, incorrect operation or loss of data.

Cleaning
Switch off all units and isolate from mains before cleaning.
Clean using a damp cloth. Do not use liquid or aerosol cleaners.

Repair of faults
Disconnect all units from power supply and have it repaired by a qualified service person if any of the following occurs:
- If any power cord or plug is damaged or frayed
- If a unit does not operate normally when operating instructions are followed
- If a unit exposed to rain/water or if any liquid has been spilled into it
- If a unit has been dropped or damaged
- If a unit shows a change in performance, indicating a need for service.

⚠ **WARNING**

Failure to adhere to these safety instructions may result in damage to the product or serious bodily injury.

RoHs
Our products are RoHs compliant.

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2. Description

- iSonic 3000 is the 4 channel device assigned to register, process and log 0/4-20 mA signals from measuring device. The main device utilization is as open channel flow meter.

- Open channel levels are measured mostly using ultrasonic/pressure sensors, which are usually powered from iSonic 3000.

- Flows are consequently calculated from measured levels using Q/h tables. Up to 4 tables and up to 100 level flow points per table are available.

- Flow tables TAB1 - TAB4 reside in processor Flash and on SD mass storage card.

- All measured and calculated units are user defined. iSonic 3000 setup, language text files and flow tables can be modified with standard text editor directly on iSonic 3000 USB mass storage.

- The log files flows.txt and daylogs.txt are TAB delimited text files and can be imported easily to any table editor.

- iSonic 3000 can be anytime USB connected to PC, tablet, Smart Phone or any device which supports USB mass storage. In the mass storage mode, the meter can be used as a standard USB key with 4 GB capacity; all information is stored as text files. Thanks to this technology, iSonic 3000 supports all OS platforms worldwide, e.g. MS Windows®, Linux, Unix, Apple, Android.

- iSonic 3000 is housed in a robust wall mounted metal case and has protection class IP67.

- The LCD display has 4 x 20 characters.

- iSonic 3000 menu is operated with 3 x front panel high endurance buttons.

- iSonic 3000 is powered from external power AC 80 - 250V / 50 - 60Hz or from external ACU 12V.

- Using ACU 12V, iSonic 3000 measures in user defined periods and goes to deep sleep mode in between to save ACU capacity.

- Standard USB connector type A is mounted in IP67 case. No special cable is needed.

- iSonic 3000 firmware can be updated by user anytime via USB.

- iSonic 3000 is controlled by newest 32 bit processor with fast 64bit arithmetic's.

- Processor is placed on a small removable PCB board, firmware upgrades can thus be carried out with a simple replacement of the processor board.

- Four channels high resolution analog current inputs are available with 0 - 20mA. Analog inputs are measured with 16bit sigma/delta ADC converter.

- Four analog outputs 0 - 20mA with 12bit DAC convertor are mounted.

- Two optical (OPTRON) pulse outputs are mounted. Max. 35V/50mA and 2 REED relays max. 200V / 500mA.

- ModBus® RS485 / RS422 galvanic isolated interface is mounted on the board.

- Optional small PCB and board are available:
    - 100Mb Ethernet with independent WEB server
    - M-Bus® board - GSM SMS board
    - GSM 3G modem additional housing connected to iSonic 3000 Ethernet
.

3. Technical specifications

Mechanical	
Housing	Metal case aluminum
Dimensions	180 x 180 x 80 mm
Protection class	IP67
Operating conditions	
Temperature:	-25 to + 45°C
LCD display	
Operating dimensions	70 x 20 mm
Type	Alphanumeric
Resolution	4 lines, 20 characters per line
Backlight	LED white, automatic shut down
Front panel button	
Type	3x IP65
Description	UP/+; Down / -; Enter
Powers	
AC power	AC 85-230V / 50 - 60Hz Consumption: 5.0 VA Fuse: Electronic

DC power	Optional: ACU 12V
	Consumption:
	  Operating mode: Max. 150mA without sensors
	  +50 mA / per sensor 4-20mA / 24V
	   Sleeping mode: Max. 2mA
	ACU charging: Automatic from AC power

OnBoard RTC battery	CR2430 user replaceable Capacity: 10 years
OnBoard GoldCap	Capacity 0.1F / 5.5V Not replaceable by the user. Dedicated for reliable built in SD card, disconnected when power shutdown
Sensor inputs	
Channels	4x current input channels 4-20mA
Sensor types	- Active 3wire sensors 24V DC powered - Passive 2 wire connection 24V sensors
Resolution	4x 16bit sigma / delta ADC converter
Error	+/- 2 bit Measured current is factory calibrated.
DAC current outputs	
Num channels	4x 4-20 mA current outputs
Resolution	12 bit DAC
Max output voltage	12V
Protection	33 V Unipolar Transil diodes 1kA
Opto relay output	
Channels	2x opto relay outputs
Max conditions	35V / 50 mA
Functions	1. Flow pulses user configurable 2. ALARM ON state, when input level is greater than user defined level border. 3. ALARM ON state, when level is smaller as defined

REED relay output	
Channels	2 x REED relay
Maximum conditions	200 V / 500 mA
Protection	Varistor
Function	1. Flow pulses user configurable 2. ALARM ON state, when input level is greater than user defined level border. 3. ALARM ON state, when level is smaller as defined
ModBus®	
Interface	RS485, RS422
Baudrate	Configurable
Address	Configurable
Isolating	Galvanic isolated 1Mbit opto
USB	
Type	USB 1.0, USB 2.0
Connection	USB mass storage
Connector	USB type B, IP65 protection
Main processor	
Type	ATMEL AT32UC3B0256
Flash memory	256 kB
RAM memory	32 kB
Power	3.3V
Optional secondary interface	
Ethernet	100 Mbit Ethernet with: - Built in WEB server - Email client - FTP client
M-Bus	Self powered M-Bus

4. Schematics
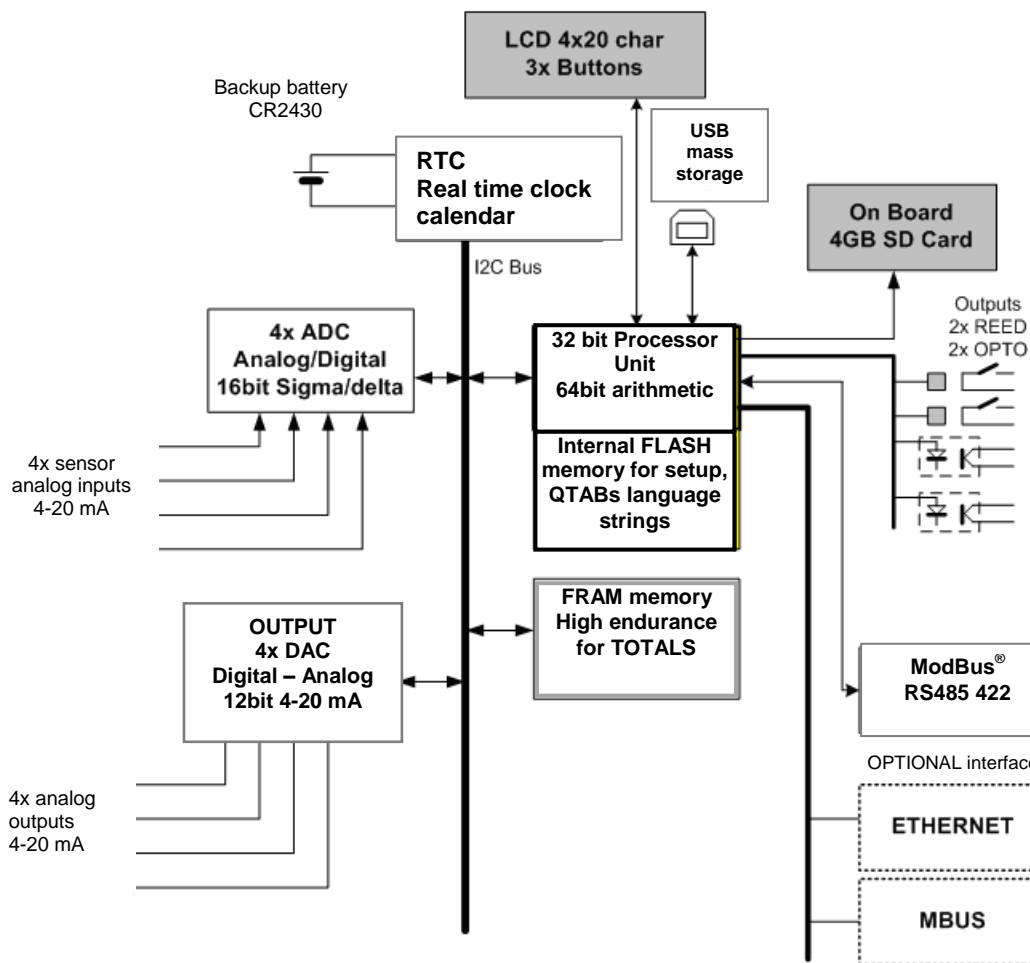
5. Processor unit

iSonic 3000 has a built-in 32 bit processor with 64bit floating point arithmetic, 32 kbit RAM, 256kB flash memory.

iSonic 3000 firmware can be upgraded via USB cable and PC software FLIP. On the processor FLASH memory are: Firmware, SETUP, flow tables – QTABS, language strings. The processor is placed on a removable board to ensure easier and more comfortable firmware upgrades.

6. Internal flash memory

In the internal flash memory resides:
• All setup values and conversions from current to level of input channels
• QTAB flow tables which are used for calculation of flow rates from level values.
• All language strings displayed on LCD

The user can upload all above information to flash from internal SD card using the iSonic 3000 LCD menu.

Also when the flash information is destroyed, it will automatically be upgraded from the SD card.
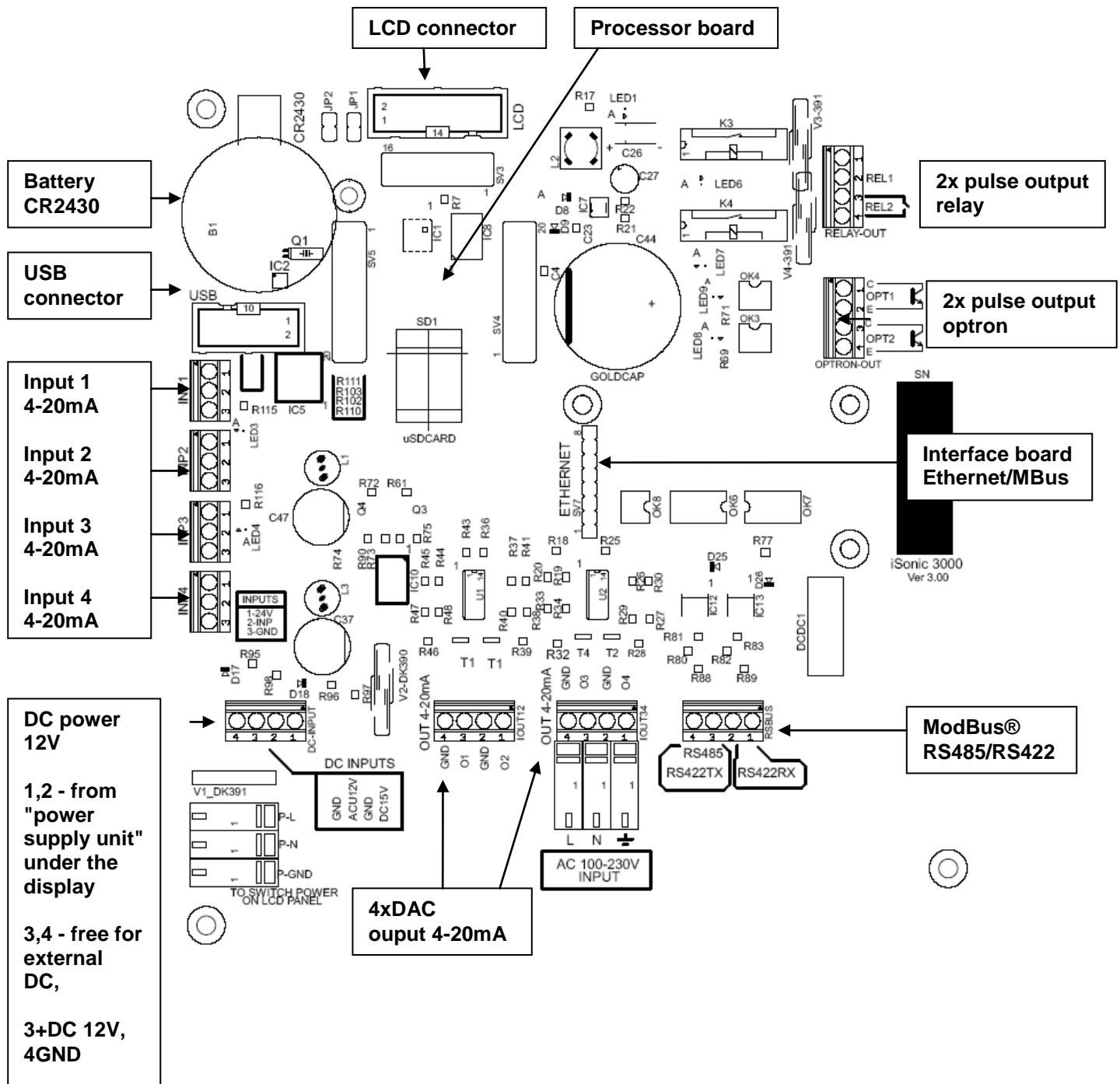
7. **FRAM memory**

FRAM is high endurance memory 64Kbit Ferroelectric nonvolatile RAM with unlimited Read/Write cycles.
FRAM memory is power independent.
In the FRAM resides all information about TOTAL values and last 60 day total amounts.
Day totals are saved on the internal SD card.

8. **Main board description**

9. USB connector

The USB – B connector in IP67 case is located on the left side of the iSonic 3000 housing. It is necessary to unscrew the connector cover. For connection between PC and iSonic 3000, please use standard USB A-B cable. For tablets or phones with micro USB connector, an OTG reduction cable is required. Tablets or phones must support USB mass storage.

iSonic 3000 USB is dedicated for download all LOG files, upgrading firmware is possible only with Windows® based OS.

10. Internal SD card

An internal, removable SD card with 4 GB capacity is mounted on the main board. The SD card connector is located under the processor board. Type push-push is used.

The following writing LOG files can be saved on the SD card memory:

• All actual values in setup period
• Day amounts
• System report text file, startup times, USB On/OFF status, etc.

All files written on the SD card are visible on PC or any device which supports USB mass storage. It is necessary to enable mass storage in the iSonic 3000 menu.

The following text files are on the SD card for services and manufacturing purposes:

• SETUP.txt all setup values
• tabX.txt where X is in range of 1 to 4 for Q/h flow tables
• Lang.txt for international language strings

11. RTC real time clock and calendar

RTC is a special silicon chip which is battery-powered (removable Lithium battery type CR2430). RTC is for real time and calendar. The battery capacity is of approx. 10 years. Connection between RTC and processor unit is made via I2C interface.

12. Sensor inputs

Four inputs are available for current output level sensors: 4 - 20mA. Max. power at 24 V for active sensors is 250 mA.
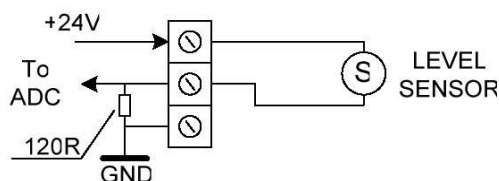Sensors inputs are protected with suppressor diodes.
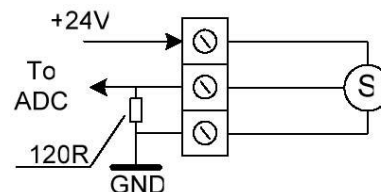Input sensing resistor has a value of 120 ohms.
Voltage on sensing resistor is measured by analog to digital converter with 16bit resolution. Each input is measured in 1 sec. period.
Connectivity to processor is under I2C bus.

2wire sensor connection   3wire level sensor

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13. DAC current 4 - 20 mA outputs

iSonic 3000 has four outputs DAC 4-20mA (DAC = Digital to Analog Converter).
Used are: 12 bit DAC.
Max. output voltage is 12V; max. value of end resistor is R= 12V / 0.020A = 600 ohms.
Each DAC output can be connected to each input specified in setup.
DAC output can be specified to types:

• DAC copied input current
• DAC copied input level with specific calculation
• DAC copied input flow with calculation defined in the setup

**4xDAC
Current amplifier**

Left – bottom
Board corner
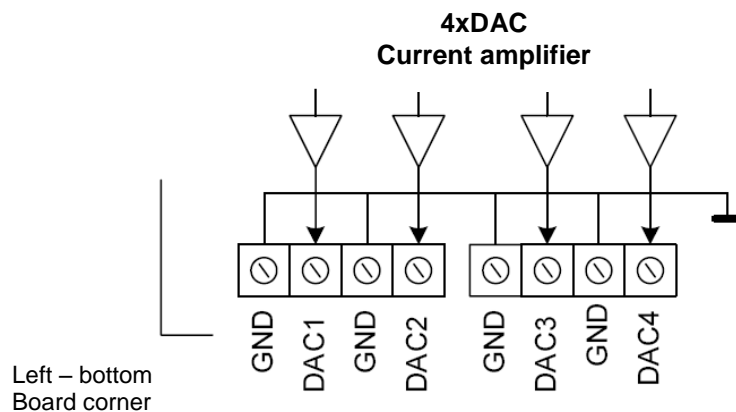
14. Pulse outputs

Two optron pulse outputs for max. 35V / 50mA and two reed relays outputs max.
200V/0.5A are available.

Each pulse output can be connected to each sensor input. The pulse output can be
programmed for 3 types: (see setup.txt)
- Pulse output for flow, for example 1 pulse for 1m^3
- Signaling if input level is higher than specific border.
- Signaling if input level is lower than specific border.

4 x pulse output	Output
1 relay 　max. 175 V/1 A	1
2 relay	2
1 opto relay 　max. 24 V/50 mA	3
2 opto relay	4

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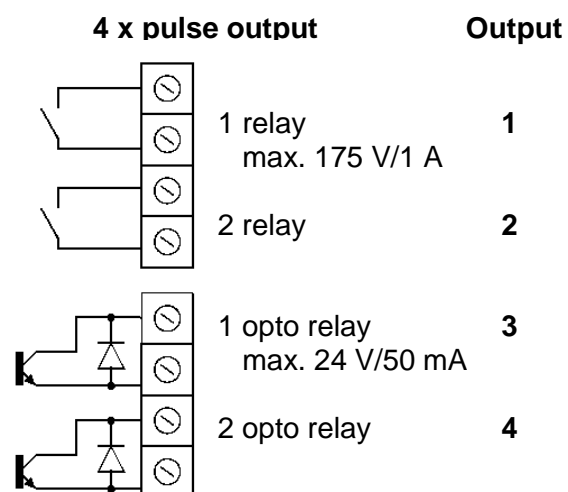
15. Work with iSonic 3000

15.1. Front panel LCD and buttons

The iSonic 3000 has a front panel LCD display with 4x 20 characters and three buttons. The LCD & buttons are IP 67 waterproof. The display gets backlighted as soon as a button has been pressed and automatically switches off after two minutes without action. Buttons names & meanings (left to right):

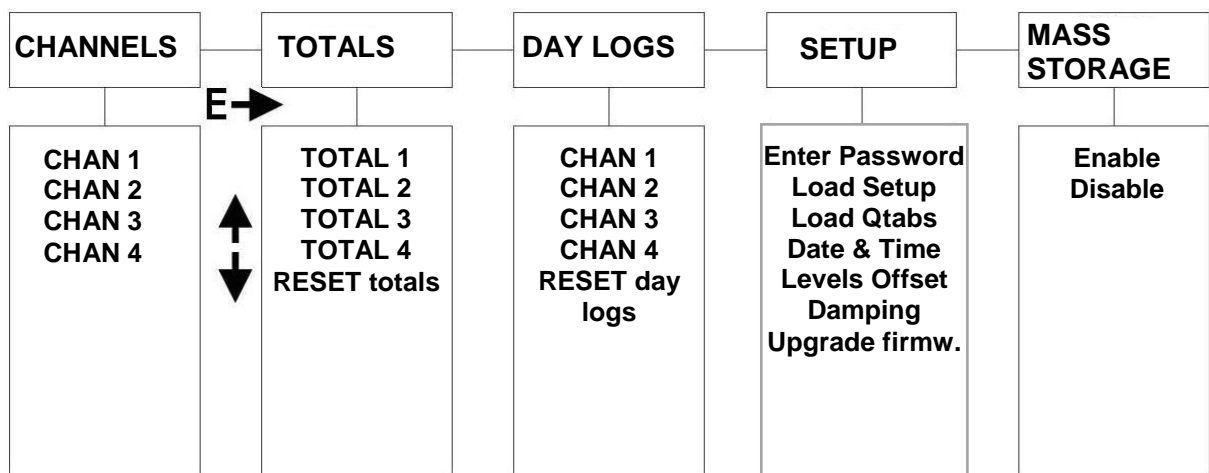+/ button. Move up in vertical menu or number increase.

-/ button. Move down in vertical menu or number decrease.

E/ button. Move right in horizontal menu; confirm value or enter the menu item and back.

15.2. Menu

CHANNELS	TOTALS	DAY LOGS	SETUP	MASS STORAGE
CHAN 1 CHAN 2 CHAN 3 CHAN 4	TOTAL 1 TOTAL 2 TOTAL 3 TOTAL 4 RESET totals	CHAN 1 CHAN 2 CHAN 3 CHAN 4 RESET day logs	Enter Password Load Setup Load Qtabs Date & Time Levels Offset Damping Upgrade firmw.	Enable Disable

Once the iSonic 3000 has been connected to power supply, the display automatically switches to channel 1 screen with no backlight. Backlight appears while pressing any button. After two minutes inactivity, the backlight switches off and the display goes to channel 1 screen (except for MASS STORAGE menu).

15.3. Menu channels

Overview of all measured and calculated values.
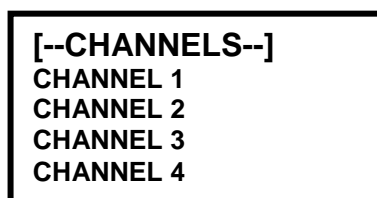
```
[--CHANNELS--]
CHANNEL 1
CHANNEL 2
CHANNEL 3
CHANNEL 4
```

To reach the channel values, move up and down with the "+" and "-" buttons. Enter the menu with "E". Inside the channels, it is possible to toggle between the channels with the "+" and "-" buttons. The "E" button brings you back to the channel list.
Press off the "E" button to display the values.

```
┌─────────────────────────────┐
│ CHANNEL NAME                │
│ Level   = 8.23 cm           │
│ Flow    = 3.1 L/s           │
│ Total   = 3123.12 m³        │
│                             │
└─────────────────────────────┘
```

Channel name toggles every 10 seconds with the date and time for three seconds. If the flow and total values are not to be calculated, only the level value will be displayed. If the channel is not used, only the message "NOT USED" will be displayed. Names of the level and flow parameters as well as the units are user selectable.

15.4.   Menu TOTALS

This menu gives you an overview of all totalizer values with date/time of their reset and overall working hours of the channel after the reset.

```
┌─────────────────────────────┐
│ [--TOTALS--]                │
│ Total 1                     │
│ Total 2                     │
│ Total 3                     │
│ Total 4                     │
│ RESET Totals                │
└─────────────────────────────┘
```

To reach the channel values, move up and down with the "+" and "-" buttons. Enter the menu with "E". Inside the channels, it is possible to toggle between the channels with the "+" and "-" buttons. The "E" button brings you back to the channel list.
Press off the "E" button to display the values.

```
┌─────────────────────────────┐
│ CHANNEL NAME                │
│ Total    = 3123.12 m³       │
│ Res      = 2. 2. 2013  16:03│
│ Work hours    = 1732        │
└─────────────────────────────┘
```

RESET Totals
Reset the total value of the each channel respectively. First select the channel by using the +/ button and confirm with the E/ button.

15.5.   Menu DAY LOGS

This menu gives you an overview of the daily amounts of each totalized channel, corresponding work hours and overall total values for each given day in the past.

```
┌─────────────────────────────┐
│ [--TOTALS--]                │
│ CHANNEL 1                   │
│ CHANNEL 2                   │
│ CHANNEL 3                   │
│ CHANNEL 4                   │
│ Clear Day logs              │
└─────────────────────────────┘
```

To reach the channel values, move up and down with the "+" and "-" buttons. Enter the menu with "E". Inside the channels, it is possible to toggle between the channels with the "+" and "-" buttons. The "E" button brings you back to the channel list. Up to 45 days back can be displayed. If the daily work time was a few seconds less than 24 hours, the exclamation mark is displayed in front of the value in hours.

```
2. 2. 2013

Amount = 232.12 m³
Work hours = !24
Total = 3123.12 m³
```

Clear Day Log
Reset the day logs values of all channels. This function deletes only day logs values stored in the memory and does not influence the daylog.csv file.

15.6.   Menu setup

```
[--SETUP--]
Enter Password
Load Setup from SD
Load QTABS from SD
Date & Time
Levels Offset
Damping
Upgrade Firmware
```

15.6.1.   Enter Password

The 4 digit password is unique for each unit. Enter the number using the "+" or "-" buttons for increment/decrement of each digit and "E" to enter the digit. Once the correct password has been entered, it is possible to use all setup menu items for 15 minutes.

- Load Setup from SD
- Load QTABS from SD
- Levels Offset
- Upgrade Firmware
- Reset Totals
- Clear Day Log

15.6.2.   Load Setup from SD

Activating this feature leads to the load off of the setup.ini and lang.txt files from the SD mass storage into the memory.

15.6.3. Load QTABS from SD

Activating this feature leads to the load off the tab1.txt.. tab4.txt files from the SD mass storage into the memory.

15.6.4. Date & time

This menu sets the actual date and time values. Select with the "+" or "-" buttons for increment/decrement of each item and press "E" to enter. The password is not necessary to access the date and time values.

15.6.5. Levels offset

This menu sets the offset value of the measured parameter (i.e. level) of each channel. First select the channel by using the "+" button and then confirm with the "E". In the first digit place, select the minus or plus sign with the "+" button; in the next digit places, enter the number using the "+" or "-" buttons for increment/decrement of each digit and "E" to enter the digit.

Example: Level sensor span is 0 – 100 cm (4 – 20 mA), sensor dead band is 10 cm; that gives the overall mount level of 110 cm over bottom level of the flume. The real mount level of the sensor is 73 cm over the bottom level of the flume. In this case, it is necessary to set the level offset value = 37 cm.

15.6.6. Damping

Used to set intervall in seconds (0-30) and to average measured values. The bigger interval is set, the slower are changes of the measured value on the display. Use the +/- buttons for increment/decrement and "E" to enter the digit.

15.6.7. Upgrade firmware

This menu allows an upgrade of the device firmware. The device must be connected to the USB port of your computer with previously installed flip.exe software and activated corresponding USB driver. First activate this menu item on the meter, then run the file isonicprog.bat on your computer.

15.7.   Menu MASS STORAGE

┌─────────────────────────────┐
│   │
│ **[--MASS STORAGE--]**   │
│   **Enable**   │
│   │
│   │
└─────────────────────────────┘

15.7.1.   Enable

Enables the possibility to reach the log files – flows.csv and daylog.csv. Files are semicolon delimited, with direct possibility to open files from the meter by MS EXCELL program.

Flow.csv/txt – all measured data in setup time interval.
Daylog.csv/txt – day log amounts with corresponding daily work hours.

In this mode, it is possible to edit directly the files setup.ini, lang txt and tab1.txt… tab4.txt in the mass storage device or in the computer and then to copy them to the mass storage device (recommended).

Setup.ini – the text file with all setup parameters for all measuring channels and outputs.
The structure of the file setup.ini is given in "Setup description" of this manual.

Tab1.txt… tab4.txt – text files with 2 tab delimited columns, representing level and corresponding flow rate values (h/Q) in units specified in setup.ini file.

Example:

0.5	0.0142
1	0.0547
2	0.2113
3	0.466
4	0.8166
5	1.2618
7	2.4318
10	4.8751
15	10.7489
20	18.8363
30	41.5311
50	112.455
80	281.1984

It is possible to write up to 100 lines with h/Q values in each file tab1.txt… tab4.txt.

Note: Once the changes have been made in setup.ini file for the names and units of parameters saved in flow.csv and daylogs.csv files, it is necessary to delete the files flow.csv and daylogs csv from the meter before starting the load setup from the SD (20.2). Only this makes the actual parameter names and units to appear correctly in the header row of the file flow. csv or daylogs.csv.

15.7.2. <u>Disable</u>

Disables the mass storage possibility and resets the meter.

To deactivate the changes made in setup.ini and lang.txt files, it is necessary to run load setup from the SD in SETUP menu (20.2) after having disabled the mass storage.

To deactivate the changes in tab1txt… tav4.txt and lang.txt files, it is necessary to run load Qtabs from the SD in SETUP menu (20.3) after having disabled the mass storage.

15.8.   Work with iSonic 3000

15.8.1   <u>iSonic 3000 programming and data retrieval overview</u>

5 steps to program an install iSonic 3000

1) Prepare the Setup.ini file by using the FlowSetup program (see chapter 15.7.1) and tab1.txt file (also tab2, tab3, tab4 where applicable) by using the FlowCalc program (see chapter 18 on a computer running the software FlowSetup and FlowCalc.
2) Connect the iSonic 3000 unit using a USB cable to your computer. The iSonic 3000 unit will appear as a disc at your computer explorer. Select the menu item MASS STORAGE/ Enable (see point 15.7.) on the iSonic 3000 unit. Copy both the Setup.ini and tab1.txt files (also tab2, tab3, tab4 where applicable) from your PC disk to the iSonic 3000 unit. Disable mass storage by pressing any key on the iSonic 3000 unit. The iSonic 3000 unit will then automatically restart.
3) Set the Unit password on the iSonic 3000 menu item SYSTEM/ Enter Password (see chapter 15.6.1). The password is shown on the main pcb board which can be found by opening the front panel of the iSonic 3000. Load Setup.ini to the iSonic 3000 memory by using the menu item SYSTEM/load Setup from SD (see chapter 15.6.2). Load tab1.txt (also tab2, tab3, tab4 where applicable), to the iSonic 3000 memory by using the menu item SYSTEM/ Load QTABS from SD (see chapter 15.6.3.)
4) Install and connect the sensor (see chapter 9).
5) Set the password by using the menu item SYSTEM/ Enter Password (see chapter 19). Set the appropriate sensor offset by menu item SYSTEM/ Levels Offset (see chapter 19).

1 step to copy the logged files from the iSonic 3000 unit
Connect the iSonic 3000 unit using a USB cable to the computer. Select the menu item MASS STORAGE/ Enable (see chapter 15.7). Copy the files flow.csv/txt and daylogs.csv/txt from the iSonic 3000 unit to your PC. Disable mass storage by pressing any key on the iSonic 3000 unit. The iSonic 3000 unit will then automatically restart.
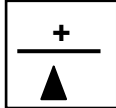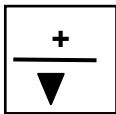
15.8.2   iSonic 3000´menu overview

Front panel LCD and buttons
iSonic 3000 have front panel LCD display 4 x 20 chars and 3 x buttons. LCD and buttons is IP67 waterproof. LCD goes white LED back lighted after any button is pressed. Automatically backlight OFF after two minutes. Buttons names and meaning (left to right).
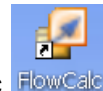
+/ button: Move up in vertical menu or number increase

-/ button: Move down in vertically in the menu or number decrease.
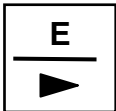
E/button: Move right horizontal in the upper menu. Confirm value or Enter the menu item and back to the menu.

16. Software installation

Install the FlowSetup `FlowSetup` and FlowCalc `FlowCalc` programs with iSonicSetup.exe file in the specified directories (e.g. C:/Program Files/iSonic3000). Subdirectory of both programs comprises the file language.tex with English texts. These can be replaced by any other language.
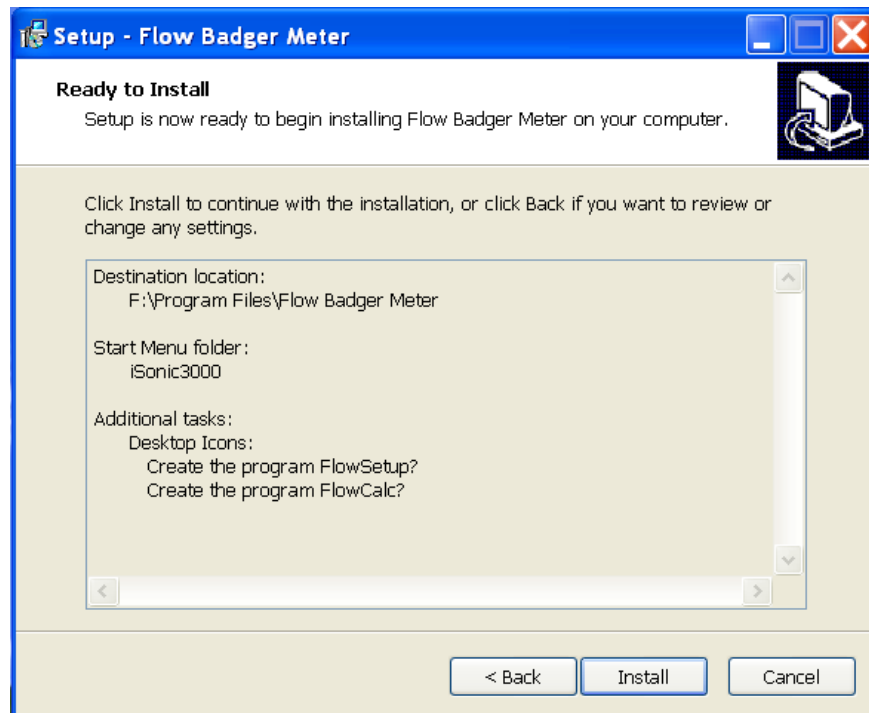
17. Software FlowSetup description

The software is used to edit the Setup.ini file. The file can be edited directly on the SD card of the device, or first saved to the selected PC folder and then copied on the SD card. It is recommended to use the second choice and to create the database of Setup.ini files on the PC.

File/Open menu option or graphic icon enables to open the existing Setup.ini file from the selected folder.

File/Save menu option or graphic icon enables to save the edited values to the Setup.ini file to the selected folder after editing.
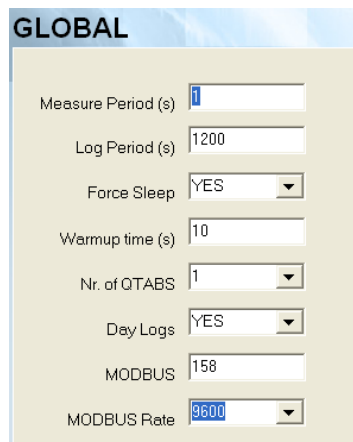
If edited Setup.ini file is saved into the program directory (e.g. C:/Program files/Flow Badger Meter), the values will appear as default with every new start of the FlowSetup program.

Setup.ini file can be edited by changing the fields in the following dialog boxes.

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Dialog Box GLOBAL

Setup of the global parameters of the device.

Measure period(s): Sets the measurement period in seconds. Standard is 1 second. If the period is greater than or equal to 60 seconds, the two measurements automatically go into the sleep mode with the blank display. This can be used when the unit is DC powered to spare the battery lifetime.
Log period(s): Sets the logging period in seconds. Must be the same number or multiplication of the measure period number.

Force sleep: Select YES -		goes to sleep mode even if Meas. Period > 60 sec
NO -		does not go to sleep mode if Meas. Period > 60 sec
Warm up time (s):		Used in sleep mode; time the sensor needs to wake up prior to measurement time.
Num QTABS:		Number of Q/h tables which are to be used by the device
Day Logs: Select YES -		enables to record the daily records into the daylogs.csv/txt files,
NO -		disables to record the daily records into the daylogs.csv/txt files
ModBus$^®$:		Number of ModBus$^®$ address – integer number.
ModBus$^®$ rate:		Selection between the ModBus$^®$ rate values.

Dialog Box CHANNELS

Setup of the measuring channels parameters for each channel respectively.

Name:	The channel name (maximum 15 characters). This text appears on the meter display. Should the channel not be used, please use only one character (e.g. x).
Value 4 mA:	Value of the measured level/parameter equal to 4 mA
Value 20 mA:	Value of the measured level/parameter equal to 20 mA
Level name:	The name of the measured level or another parameter (e.g. temperature). This text appears on the meter display and written in the flows.csv/txt files.
Level unit:	The measured level/parameter unit. This text appears on the meter display and iswritten in the flows.csv/txt files.
Level decimals	Select (1-6) of the measured level/parameter decimal number
QTAB Nr.	Selection of the QTAB (file tab1- tab4.txt, 0-4), which is used to calculate the flow of this channel. Should the flow rate value not be displayed on the meter, set this parameter to 0.
Level log:	Select YES - enables to write the measured level/parameter into the flows.csv/txt files.
	NO - disables writing the measured level/parameter into the flows.csv/txt files.
Calculate flow:	Select YES - enables to calculate the flow rate from measured para- meter and write to the flows.csv/txt files.
	NO - disables calculating the flow rate from measured para- meter and write to the flows.csv/txt files,

Flow name: The name of calculated flow rate parameter (maximum 15 characters). This text appears on the meter display and in the flows.csv/txt files.

Flow rate unit: The calculated flow rate parameter unit. This text appears on the meter display and in the flows.csv/txt files.

Flow decimals – Selection (1-6) of the flow rate decimal places number.

Time divisor –   The integer number representing the time base used for flow rate (1- seconds, 60- minutes, 3600 – hours, etc.)

Amount divisor – The ratio between the volume units used for the flow rate and Total (e.g. L:m^3 =1000). Should the total value not be calculated nor display- ed, please set this parameter to 0.

Total unit: The calculated total parameter unit. This text appears on the meter display and in the flows.csv/txt files.

Total decimals – Selection (1-6) of the total decimal number.

Dialog Box PULSE OUTPUTS

Setup of the pulse output parameters for each output . Outputs 1 and 2 are opto relay solid state, 3 and 4 relay outputs.

Connect to: Informs which input channel is connected to which output channel.
          Select (0-4), 0 means that output is not used.

Type: Select   Not used   Output is not used
                   Total   Pulse output of flow total
                   Level >   Relay is ON if measured level/parameter is > COEF
                   Level <   Relay is ON if measured level/parameter is < COEF
                   Flow >   Relay is ON if calculated flowrate is > COEF
                   Flow >   Relay is ON if calculated flowrate is < COEF

Coefficient: If TYPE is = 1, it calculates the pulse number for total value changes.

[e.g, 1.0 means 1 pulse for 1m^3 (if total is in m^3), 10.0 means 10 pulses for 1m^3, 0.1 means 1 pulse for 10.0 m^3, etc.]

Hysteresis: The value in level / parameter or flow units.

Set the hysteresis (dead band) for the high or low alarms
(Type Level>, Level<, Flow>, Flow<).

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Dialog Box DAC OUTPUTS

Setup of the 4-20 mA DAC output parameters for each output respectively.

DAC OUTPUTS

| Output1 | Output2 | Output3 | Output4 |

Connect to [1 ▼]   Value 4 mA [0]

Type [Flow ▼]   Value 20 mA [100]

Connect to: Informs which input channel is connected to which ouput channel.
Select (0-4), 0 means output is not used

Type: Says which parameter represents DAC output

Select	Not used	Output is not used
	= Input	DAC copies sensor input current 4 - 20mA
	Level	DAC produce current output from measured level/parameter
	Flow	DAC produce current output from calculated flow

Value 4 mA: Value of the output parameter is equal to 4 mA.

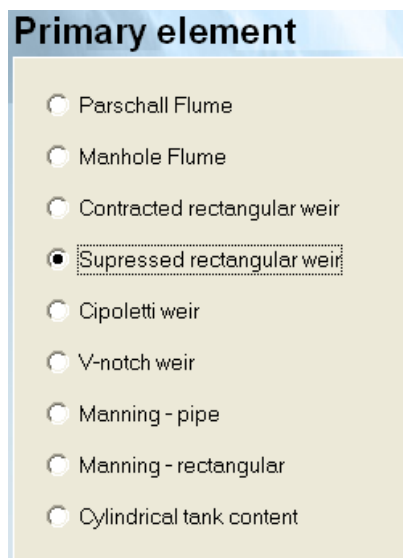Value 20 mA: Value of the output parameter is equal to 20 mA.

18. Software FlowCalc description

The software is used to create and edit the tab1.txt and tab4.txt files with h/Q data representing particular primary flow element. The files can be edited directly on the SD card of the device or on the PC folder and then copied to the SD card. It is recommended to use the second choice and to create the database of tab1.txt and tab4.files on the PC.

File/Open menu option or graphic icon enables to open the existing 2 column (h/Q) tab delimited text file. It is also possible to open the 1 column text file with level values (h) only.

File/Save menu option or graphic icon enables to save the calculated values to the 2 column tab delimited text files (h/Q) into the selected folder after the flow calculation. For the iSonic 3000 the files must be given names tab1.txt, tab2.txt, tab3.txt or tab4.txt

Primary element can be selected in the dialog box on the left side:

The same action can be carried out from the menu **Primary element**
/Parschall Flume
/Manhole Flume
/Contracted rectangular weir
/Suppressed rectangular weir
/Cipoletti weir
**/V-notch weir**
/Manning pipe
/Manning rectangular

Formulas for each primary element and Manning equation are described in Appendix B of this manual.
Manning equation is selected when it is necessary to calculate the flow curve of the circular or angular free flow profile without any primary flow element (flume, weir).
The last choice **/Cylindrical tank content** is used to calculate the volume curve of the cylindrical tank.

In the dialog box **Units** it is also necessary to select the appropriate level and flow rate units. The calculated flow rate values will appear in these units. It is possible to combine any level and flow rate unit.
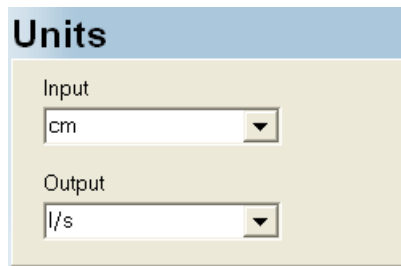
The dialog box **Dimension** offers the possibility to specify either the dimension of the primary flow element or to fill in the parameters of the appropriate equation (see Appendix C).
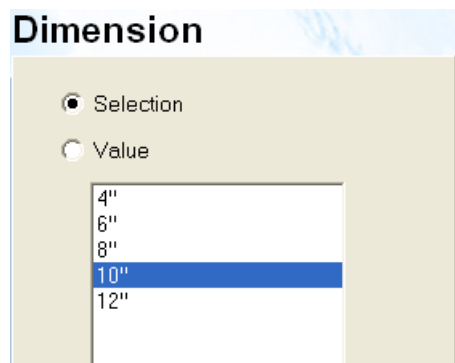
In the dialog box **Flow (Q),** it is possible to either fill the appropriate level values or load one or two column tab delimited text files.
Grafical icons:

 Enables to open the tab1.txt - tab4.txt or any other 1 or 2 column tab delimited text file.

 Enables to save the calculated values to the 2 column tab delimited text file (tab1.txt - tab4.txt file) into the selected folder and consequently to the iSonic 3000 SC card.

 Enables to delete the line with cursor from the table.

 Enables to redraw the calculated h/Q curve **Graph**.
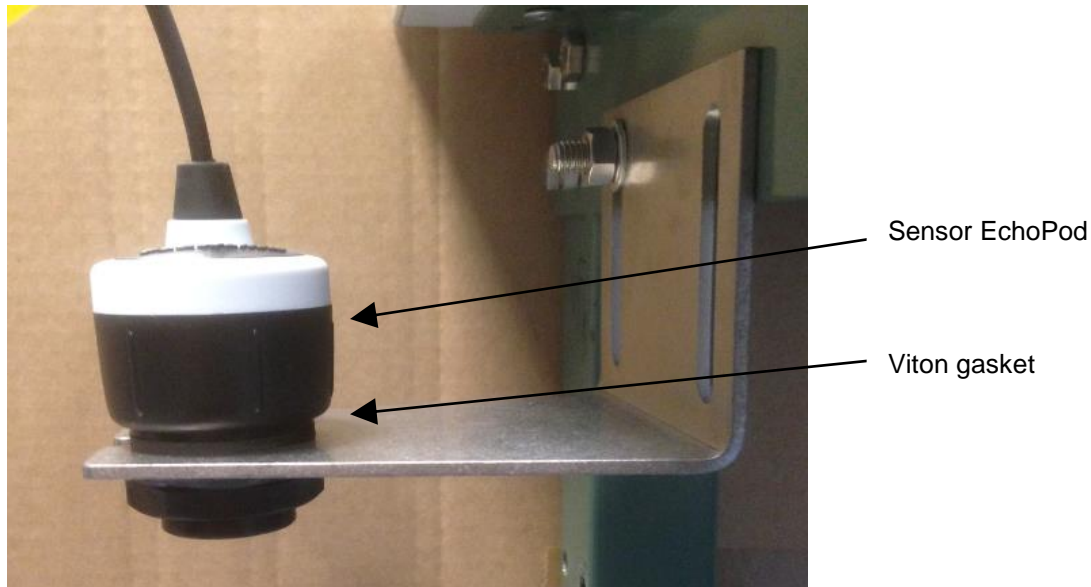

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Decimals – selection of decimal places of calculated flow rate values.

Click on the **Flow Calculation** button to calculate the flow rate values according to specified primary element and units. The calculated values are displayed in the **Graph** below
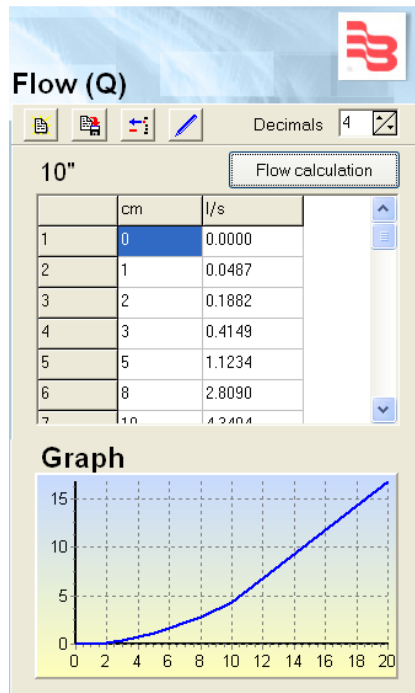
19. Installation of sensor EchoPod DL-10

Sensor EchoPod

Viton gasket

Installation of the sensor:

Screw the sensor into the stainless steel mounting bracket while using the gaskets.

EchoPod

Min. 5 cm

Max. 125 cm

FLOW
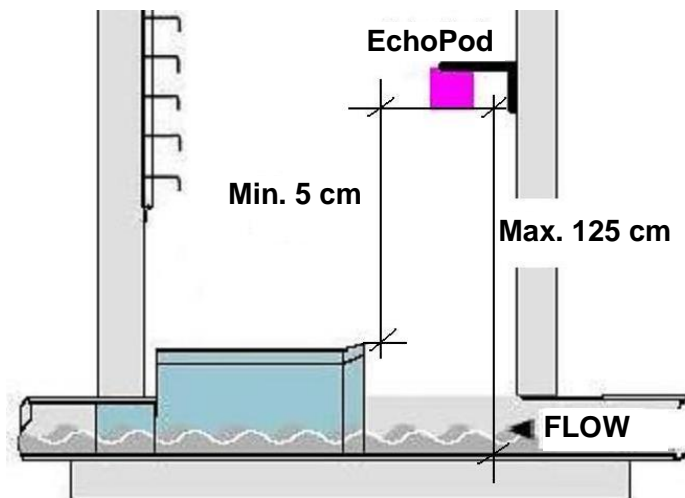
Sensor must be installed maximum 125 cm above the flume bottom (minimal measured level) with a minimum of 5 cm distance above the maximal measured level.

EchoPod DL-10 connection to iSonic 3000 4-20 mA input terminal:

+24V

red wire

To
ADC

black wire

120R

GND

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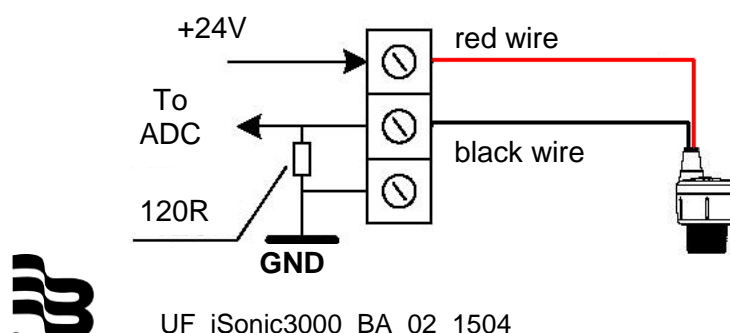
20. Appendix A: Setup description

```
; ----- iSonic 1.0 setup file ---
; Please everywhere in text do not use brackets,
; its for sections names, see section name: G L O B A L

; !!! WARNING !!! FOR floating point NUMBERS use as decimal separator dot <.>, NOT
commas <,>

[GLOBAL]

; periods are in seconds
MEASPERIOD = 1
LOGPERIOD  = 10

; Sleeping mode if device is 12V battery-powered
; go to sleep if measper < 60 sec
FORCESLEEP = 1

; number of Q/h tables max=4 , files: tab1.txt, tab2.txt ...
NUMQTABS =3

; enable / disable recording amounts
LOG_DAY=1

;address of MODBUS RS485/RS422 interface
MODBUS=158
MODBUS_RATE=9600


;----------------------------
;--- INPUT channel 1 setup---
;    with Full Description
;----------------------------

[ICHAN_1]
; channel name is string max 15chars
; if channel is not used enter only 1 char  e.g x
NAME=Parshall FLUME
```

;---- Level Calibration Coefs --
; Linear level coefs for sensor output current mA
; LCAL4 inform level for sensor current 4 ma LCAL20 is level for 20 mA
LCAL4 = 0.0
LCAL20 = 290

;-- LEVEL_NAME max. 16 digits string for name of level, etc., level, temp, PH,...
LEVEL_NAME=Level

; Level units string
LEVEL_UNITS =cm

; number of decimal digits
LEVEL_DIGITS=1

; 1=enable/ 0=disable Level recording to file flows.txt
LEVEL_LOG=1

; enable actual flow recording
FLOW_LOG=1

; which Qtab is used for calculate flow, enter 0 if Qtab is not used - flow rate value will
not be displayed on the meter.
QTABID=1

;-- FLOW_NAME max 15 digits string for name of flow rate, volume, etc.
FLOW_NAME=Flow

; actual/momentarry flow units
FLOW_UNITS=L/s

; number of decimal digits
FLOW_DIGITS=3

; --- total flow divisors ----
; this coeficient refer to how the total counter is divided by time
; example: if actual flow is lit/sec then coef =1
;   if actflow = lit/min then time divisor is 60
;   if actflow = lit/hour then time divisor is 3600
TIME_DIVISOR=1

; this coef refer to how the actual flow is added to total counter
; if actual flow is in liter and total in m^3 is needed, then use divisor 1000
; if total should not be calculated nor displayed, then use divisor 0
AMOUNT_DIVISOR= 1000

;-- total amount units
; e.g: m^3 meaning cubic meter
TOTAL_UNITS=m^3

; number of decimal digits
TOTAL_DIGITS=1

;---------------------------
;--- INPUT channel 2 setup---
;---------------------------
[ICHAN_2]
NAME=CHAN2
LCAL4 = 0,0
LCAL20 = 290.0
LEVEL_NAME=Level
LEVEL_UNITS =cm
LEVEL_DIGITS=2
QTABID=2
LEVEL_LOG=1
FLOW_LOG=1
FLOW_NAME=Flow
FLOW_UNITS=L/s
FLOW_DIGITS=3
TIME_DIVISOR=1
AMOUNT_DIVISOR= 1000
TOTAL_UNITS=m3
TOTAL_DIGITS=2

;--- INPUT channel 3 setup---
; this is only temperature, QTAB is not used, totalizer is not used
[ICHAN_3]
NAME=CHAN3
LCAL4 = 0.0
LCAL20 = 100
LEVEL_NAME=Temperature
LEVEL_LOG=1
FLOW_LOG=0
QTABID=0
LEVEL_UNITS =°C
LEVEL_DIGITS=1
FLOW_UNITS=xx
FLOW_NAME=xxx
FLOW_DIGITS=1

```
        TIME_DIVISOR=1
        AMOUNT_DIVISOR=0
        TOTAL_UNITS=xx
        TOTAL_DIGITS=1



;--- INPUT channel 4 setup---
[ICHAN_4]
; channel not used if length name is shorter than 3
NAME=x
LCAL4 = 0.0
LCAL20 = 100
LEVEL_NAME=xx
LEVEL_LOG=0
FLOW_LOG=0
QTABID=0
LEVEL_UNITS =cm
LEVEL_DIGITS=2
FLOW_UNITS=l/s
FLOW_NAME=xx
FLOW_DIGITS=3
TIME_DIVISOR=1
AMOUNT_DIVISOR=0
TOTAL_UNITS=m³
TOTAL_DIGITS=3



; ------ OUTPUT RELAYs -----------
; RELAY 1  is optical, max 30V/50mA

[RELAY_1]

; next value inform on which input channel the DAC is connected: 1..4
; 0 meaning not used
CONNECT=1

;-- TYPE of relay output---
;0   relay is not used
;1   relay pulse output of flow total
;2   relay is ON if level is > COEF
;3   relay is ON if level is < COEF
;4   relay is ON if flow is > COEF
;5   relay is ON if flow is < COEF
TYPE= 1
```

TOTAL_UNITS=m^3

; COEF description if TYPE is = 1
; coeficient calculates the number of pulses for total value changes
; e.g, 1.0 meaning 1 pulse for 1m^3 if total is in m^3
; e.g. 10.0 meaning 10 pulses for 1m^3
; e.g. 0.1   mean 1 pulse for 10.0 m^3
COEF= 100.0

; the value in level/parameter or flow units. Set the hysteresis (dead band) for the ; high
or low alarms (Type Level >,Level <,Flow>,Flow <)
HYSTER=5.0

; RELAY 2 is optical, max. 30V/50mA
[RELAY_2]
CONNECT=1
TYPE=1
COEF= 100.0
HYSTER=5.0

; RELAY 3 is REED contact, max. 200V/0.5A
[RELAY_3]
CONNECT=0
TYPE=0
COEF= 0.0
HYSTER=5.0

; RELAY 4 is REED contact, max. 200V/0.5A
[RELAY_4]
CONNECT= 1
TYPE=3
COEF= 0.0
HYSTER=5.0

```
; ------ SETUP 4xDAC outputs 0..20mA -------
[DAC_1]

; next value informs on which input channel the DAC is connected: 1..4, 0=meaning not
used
CONNECT=1

; which kind of input value is in the DAC output
; 0= DAC is not used
; 1= DAC copied sensor input current 4-20mA
; 2= DAC copied level of input channel,
; 3= DAC produce current from flow
DACTYPE=2

; value for 4 mA output e.g. for level 0 cm
COEF4MA=0

; value for output 20 mA, e.g 100.0 cm for 20 mA
COEF20MA=100

; dac 2 config
[DAC_2]
CONNECT=0
DACTYPE=2
COEF4MA=1
COEF20MA=101

; dac 3 config NOT used
[DAC_3]
CONNECT=0
DACTYPE= 0
COEF4MA=0
COEF20MA=0

; dac 4 config, NOT used
[DAC_4]
CONNECT=0
DACTYPE= 0
COEF4MA=0.2
COEF20MA=10.2
```

21. Appendix B: ModBus® implementation

Hardware description

- Communication between controller or central unit and iSonic 3000 ModBus® interface is on the RS485 interface bus.
- Default bit rate is 9600 b/s
- iSonic 3000 device address is defined in setup.ini in section [GLOBAL]
  keyword: MODBUS=addr
  where addr is in range: 1 to 254
- Max length of connection cable is 500m.
  Twisted pair cable is strongly recommended.
  Shielding is not recommended; if shielding is needed (for ex. in hospitals, airports or where EMC from cable may be dangerous), cable shield must be connected in one point only to central building ground.

Protocol description

Master – Controller requests data from iSonic 3000 with command message:

Station n°:	iSonic addr
Function n°:	Command
Data	
CRC checksum	

iSonic 3000 supports only read word data function FUNCTION n° 03h.

Request message from controller structure:

Station n°:	iSonic addr
Function read data:	03h
Start address of data:	2 bytes Lo address Hi address
Number of requested words:	2 bytes Lo, Hi
CRC checksum	2 bytes

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iSonic 3000 address memory description:

All iSonic 3000 data are stored in the memory addressing map:

Word address decimal	Meaning
0 to 3	8 BYTE serial number In ASCII interpretation
4 to 7	8 BYTE in ASCII ISONIC verno
8 to 15	16 BYTE in ASCII Channel-1 name
16 to 23	16 BYTE Level-1 name ASCII
24 to 31	16 BYTE Level-1 value in ASCII format such: 13.51
32 to 39	16 BYTE Level-1 units
40 to 47	Flow-1 name
48 to 55	Flow-1 actual value
56 to 63	Flow-1 Units
64 to 71	Total-1 name
72 to 79	Total-1 value
80 to 87	Total-1 Units
88	16 BYTE in ASCII Channel-2 name
96	16 BYTE Level-2 name ASCII
104	16 BYTE Level-2 value in ASCII format
112	16 BYTE Level-2 units
120	Flow-2 name
128	Flow-2 actual value
136	Flow-2 units
144	Total-2 name
152	Total-2 value
160	Total-2 units

168	16 BYTE in ASCII Channel-3 name
176	16 BYTE Level-3 name ASCII
184	16 BYTE Level-3 value in ASCII format
192	16 BYTE Level-3 units
200	Flow-3 name
208	Flow-3 actual value
216	Flow-3 units
224	Total-3 name
232	Total-3 value
240	Total-3 units
248	16 BYTE in ASCII Channel-4 name
256	16 BYTE Level-4 name ASCII
264	16 BYTE Level-4 value in ASCII format
272	16 BYTE Level-4 Units
280	Flow-4 name
288	Flow-4 actual value
296	Flow-4 units
304	Total-4 name
312	Total-4 value
320	Total-4 units

Notes:

Each channel is described with a:

Channel name = string of 8 words = 16 ASCII bytes
Level name: 16 bytes
Level value: 16 bytes in ASCII
Level units: 16 bytes in ASCII

Flow name: 16 bytes
Flow value: 16 bytes in ASCII
Flow units: 16 bytes in ASCII

Total name: 16 bytes
Total value: 16 bytes in ASCII
Total units: 16 bytes in ASCII

Returned message from iSonic 3000:

Station n°:	1BYTE iSonic 3000 address
Function code:	03h
Number of sending bytes	xxx
Data	
CRC cheksum	
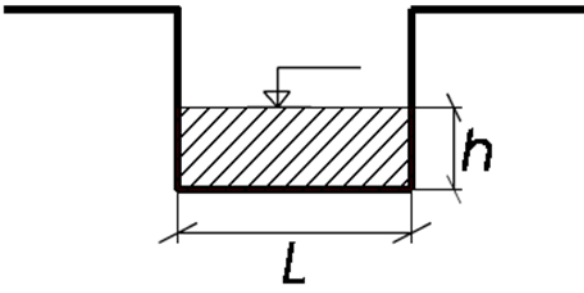
22. Appendix C: Flume and weir equation summary
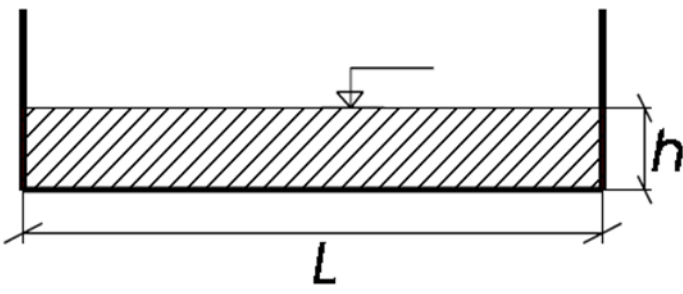
Parshall flume		Q=Kh^n				
	n	K (m, m^3/s)	K (cm,L/s)	K (inch, USgal/s)	K (inch, USgal/min)	K (feet, cfs)
1"	1,55	0,0604	0,0480	0,0538	3,23	0,338
2"	1,55	0,1207	0,0959	0,1074	6,45	0,678
3"	1,55	0,1771	0,1407	0,1576	9,46	0,992
6"	1,58	0,381	0,2636	0,3037	18,22	2,06
9"	1,53	0,535	0,4660	0,5124	30,75	3,07
1ft	1,55	0,705	0,5600	0,6274	37,65	3,95
1.5ft	1,55	1,067	0,8475	0,9496	56,98	5,975
2ft	1,55	1,429	1,1351	1,2718	76,31	8
3ft	1,57	2,19	1,5865	1,8110	108,66	12
4ft	1,58	2,96	2,0478	2,3595	141,57	16
5ft	1,59	3,75	2,4776	2,8814	172,88	20
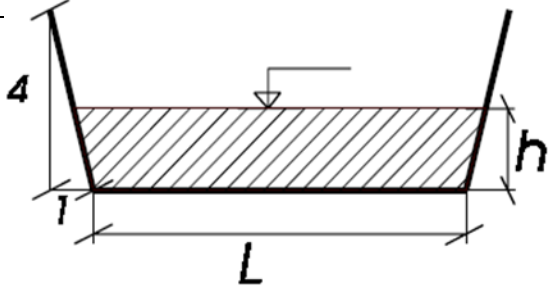
	n	K (m, m^3/s)	K (cm,L/s)	K (inch, USgal/s)	K (inch, USgal/min)	K (feet, cfs)
PR1	1,552	0,0609	0,0479	0,0538	3,23	0,340
PR2	1,553	0,1197	0,0938	0,1054	6,32	0,668
PR3	1,555	0,1784	0,1385	0,1559	9,35	0,993
PR4	1,558	0,354	0,2710	0,3059	18,36	1,963
PR5	1,558	0,521	0,3989	0,4503	27,02	2,889
PR6	1,556	0,675	0,5216	0,5876	35,26	3,752
PR7	1,56	1,015	0,7700	0,8708	52,25	5,615
PR8	1,564	1,368	1,0188	1,1565	69,39	7,531
PR9	1,569	2,081	1,5145	1,7272	103,63	11,389
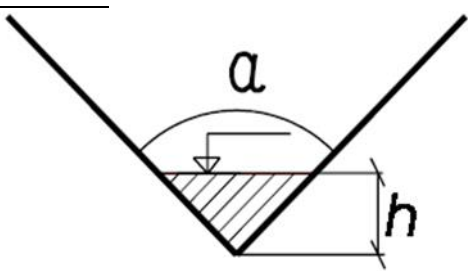
Manhole flume		Q=Kh^n				
	n	K (m, m^3/s)	K (cm, i/s)	K (inch, US gal/min)	K (inch, US gal/min)	K (feet, cfs)
4"	1,95	0,2343	0,0295	0,0480	2,88	0,816
6"	1,95	0,3026	0,0381	0,0620	3,72	1,053
8"	1,95	0,3424	0,0431	0,0701	4,21	1,192
10"	1,95	0,3868	0,0487	0,0792	4,75	1,346
12"	1,95	0,4345	0,0547	0,0890	5,34	1,512

Contracted rectangular weir
Q=K(L-0.2h)h^n

n	K (m, m^3/s)	K (cm, L/s)	K (inch, US gal/sec)	K (inch, US gal/min)	K (feet, cfs)
1,5	1,84	0,0184	0,0500	3,00	3,33

Suppressed rectangular weir
$Q=K(L)h^n$

n	K (m, m³/s)	K (cm, L/s)	K (inch, US gal/s)	K (inch, US gal/min)	K (feet, cfs)
1,5	1,84	0,0184	0,0500	3,00	3,33

Cipoletti weir
$Q=K(L)h^n$

n	K (m, m³/s)	K (cm, L/s)	K (inch, US gal/s)	K (inch, US gal/min)	K (feet, cfs)
1,5	1,86	0,0186	0,0505	3,03	3,367

V-notch weir,30°,45°,60°,90°
$Q=8/15*(2g)^{0.5} \tan(\alpha/2)C(h+k)^{2.5}$

g- acceleration due to gravity, 9.806 ms⁻², 980.6 cms⁻², 386.06 inchs⁻², 32.2 fts⁻²

α°	k (m, m³/s)	k (cm, l/s)	k (inch, US gal/s)	k (inch, US gal/min)	k (feet, cfs)
30,00	0,0021	0,210000	0,0827	0,0827	0,007
45,00	0,0015	0,150000	0,0591	0,0591	0,005
60,00	0,0012	0,120000	0,0472	0,0472	0,0038
90,00	0,0008	0,080000	0,0315	0,0315	0,0026

α°	C (m, m³/s)	C (cm,L/s)	C (inch, gal/s)	C (inch, gal/min)	C (feet, cfs)
30,00	0,586	0,000586	0,00254	0,152	0,586
45,00	0,580	0,000580	0,00251	0,151	0,580
60,00	0,577	0,000577	0,00250	0,150	0,577
90,00	0,578	0,000578	0,00250	0,150	0,578

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Manning equation $Q = k/n\, R_h^{2/3} I^{1/2} A$

k (m, m^3/s)	k (feet, cfs)
1	1,49

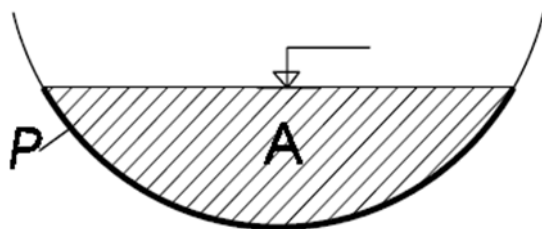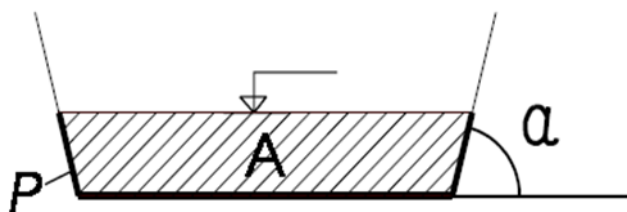n - Gauckler-manning coeficient
    represents surface roughness (0.011-0.08)

Rh - hydraulic radius   A - cross sectional area

$R_h = A/P$ P - wetted perimeter
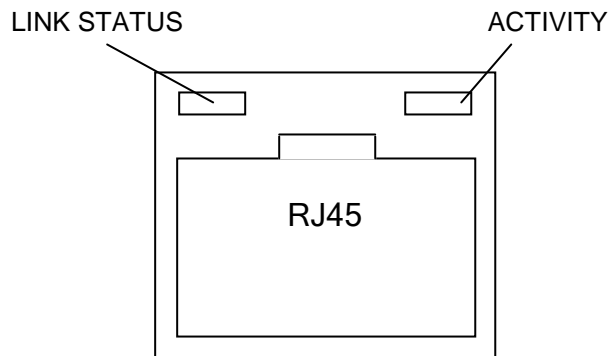
23. **Appendix D: Ethernet module guide**

The Ethernet module is an optional module of the iSonic 3000.
Factory delivered is a DHCP module, which means that the user must have a DHCP router with DHCP support.

LED's are built on the Ethernet module.
LED activity must flash after power ON.
LED link status must light as soon as the connection to Ethernet has been established.

The Ethernet module has a built-in dynamic web server, e-mail client and FTP client.

The IP address of the module will be required to connect the iSonic 3000.
For this, please download the software under http:/ora-ltd.com/ISONIC/Finder.zip
Unpack finder.exe and run it.
Finder.exe will search your network to iSonic 3000 Ethernet module and inform you about the IP address.
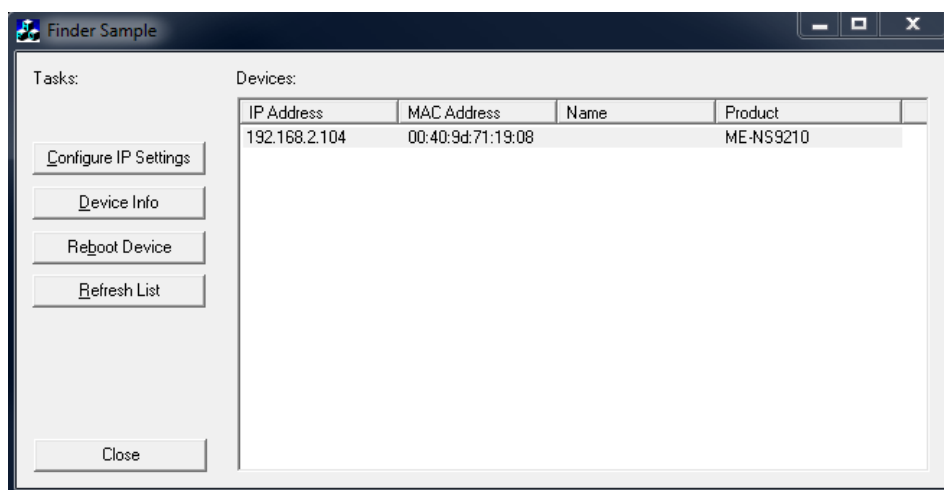
Finder must detect iSonic module; in the above example, the IP address is
192.168.2.104

Another method to search the IP address is to connect your network router and open the status: DHCP Clients.

In Finder.exe it is possible to setup the iSonic module to static IP address. A password is needed to make changes. The password is "**password**"

To connect the Ethernet module, open your browser (CHROME, Opera, IE, FireFox, etc.) and write the IP address of the module in the address line.

User and password will be requested. Default and factory user is admin; password is 123456.

For read only, user is emh password= 123456

Two users are saved: **admin** and emh. The passwords can be changed in the setup menu.
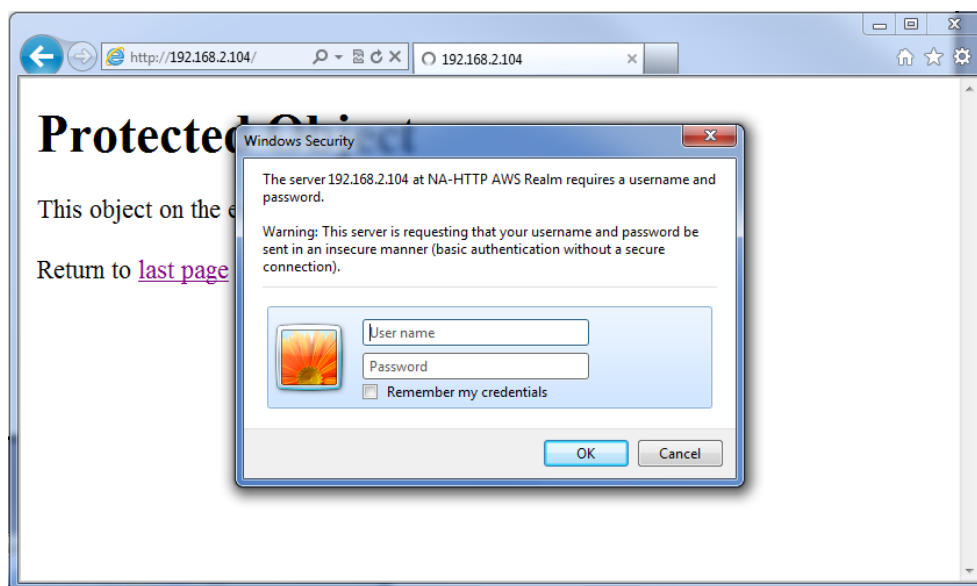
24. Return of goods for repair / Harmlessness declaration

Please revert to the form under: www.badgermeter.de/service/return-of-goods.

Hotline

Tel.   **+49-7025-9208-0 or -79**
Fax   **+49-7025-9208-15**